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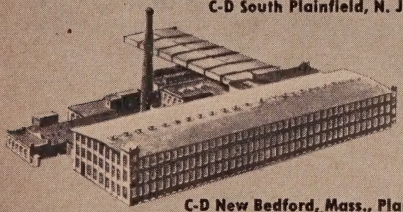

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Vol. 19 FEBRUARY, 1954 No. 2

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CHECKING AMATEUR FM TRANSMITTERS

Although amateur FM has been authorized for several years and a fair amount of FM activity is being carried on in allocated ham bands, few amateurs we have contacted actually measure the frequency modulation of their transmitters. They are inclined instead, to rely upon reception reports from stations contacted. The reason for this seems to be unfamiliarity with test methods. There is false belief that FM measurements require instruments outside of amateur budgets.

Amateur stations using amplitude modulation are equipped with one or more devices, such as oscilloscope and modulation meter, for checking quantitatively the modulation percentage. They usually have also some form of monitor, such as a diode detector or small auxiliary receiver for aurally checking voice quality. The attention commonly paid to the excellence of AM transmissions apparently is not being matched in FM practice. Nevertheless, it is the ham's responsibility, imposed by the Law, to know how much of the spectrum his frequency-modulated signals occupy and it is his concern to minimize distortion in his transmissions.

The purpose of this article is to explain how to measure frequency modulation with equipment within the reach of the amateur, and to explain the process in simple language. Prior to the discussion of several test methods, we will review quite briefly the salient features of the FM signal.

Nature of the FM Signal

While being modulated, a correctly adjusted FM transmitter delivers a signal of constant amplitude but variable frequency. As long as no modulation is applied, the radiated signal is a constant carrier at the selected operating frequency, varying neither in amplitude nor frequency.

The radio-frequency excursions during modulation are both above and below the carrier frequency as a mean value, and in a linearly-operating transmitter the deviations are equal at all points in both directions. The carrier is shifted up and down in frequency at a rate corresponding to the audio modulating frequency. The carrier value is attained only at such times as the a. f. cycle is passing through zero. Positive a. f. half-cycles ordinarily shift the frequency up from the carrier value; negative half-cycles below the carrier value. The distance in cycles or kilocycles through which the carrier is shifted is governed by the peak amplitude of the a. f. modulating voltage.

Another way of stating the foregoing is: (1) In frequency modulation, the audio modulation shifts the r. f. output frequency to values plus and minus the carrier (center) frequency. (2) The output r. f. amplitude is constant. (3) The shifting rate is equal to the audio modulating frequency. (4) The frequency deviation is proportional to the peak a. f. modulating voltage as long as the transmitter is operated within limits of linearity.

At any given peak a. f. modulating voltage, the deviation is identical for all modulating frequencies, including even corresponding static d. c. levels.

An FM detector, in a receiver or test instrument, is frequency-sensitive. It converts radio-frequency deviations into a. f. alternations. The output audio frequency is identical with the deviation rate. The a. f. output amplitude of this detector is proportional to the amount of deviation in the signal.

Checking Methods

There are two general methods of checking frequency modulation —

CORRECTIONS

On Page 9 of the December 1953 issue in the self-excited Signal Injector Circuit (B), the junction of capacitor C_x and the secondary of transformer T should be grounded.

Also see Page 10.

indirect and direct. In the indirect method, the transmitter oscillator first is tested to determine its frequency deviation for various applied modulation voltages. A monitoring device, such as a peak voltmeter, then is installed in the transmitter and its indications of modulation voltage are interpreted, on the basis of the first tests, as so much frequency deviation. Thus, the indirect method does not make measurements on the actual FM carrier.

In the direct method, the FM carrier is sampled, and the amplitude of the a. f. output voltage from the calibrated FM detector is translated into cycles or kilocycles deviation. The sampling device may be an FM receiver.

The indirect method will be discussed first because it makes use of common equipment available to most amateurs.

Selective Receiver with Beat-Note Indicator. In this method, a selective AM receiver with internal BFO, such as a stable communications receiver, is required. Also needed is some accurate device for measuring the frequency of beat notes in the a. f. output of the receiver, and a source of accurately-known adjustable d. c. voltage.

The procedure is to apply a variable

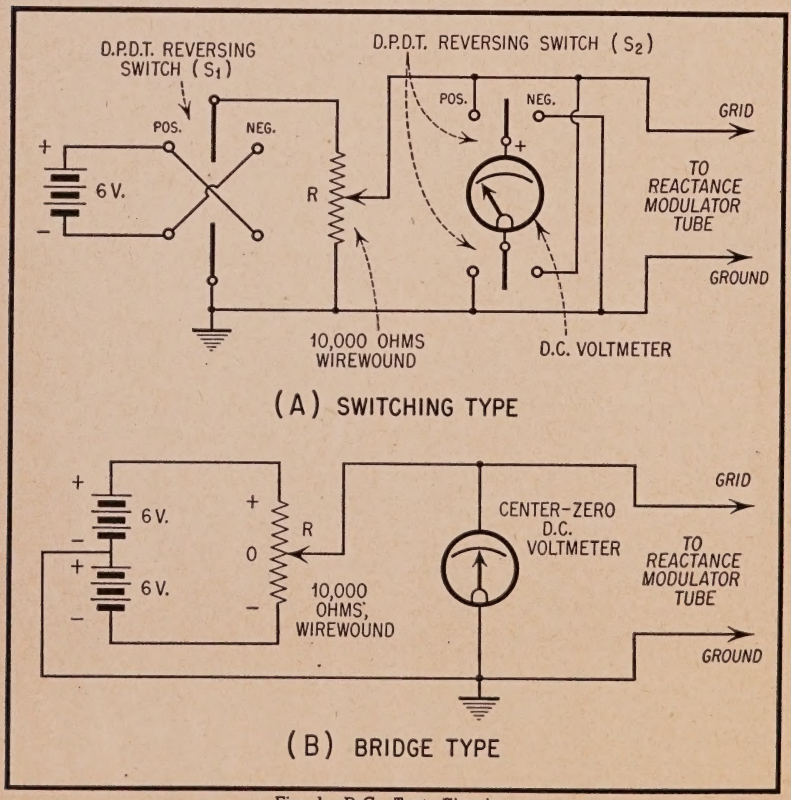


Fig. 1. D.C. Test Circuits.

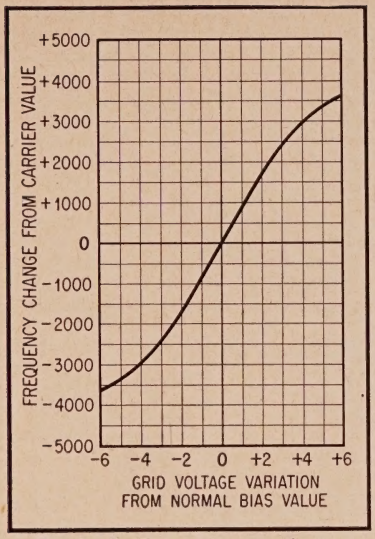


Fig. 2. Oscillator Linearity Curve.

d. c. voltage to the grid of the reactance modulator tube in the FM transmitter and to note the resultant frequency change. Provision must be made to vary this voltage both positively and negatively. This will vary the grid bias on the modulator tube both above and below its normal level. The frequency of the FM oscillator controlled by the reactance tube will vary above and below its carrier value in step with the voltage levels. The receiver is tuned to zero beat with the unmodulated carrier and then used in conjunction with the zero-beat indicator to determine the oscillator frequency change vs. applied d. c. voltage. A curve is drawn to record these data. The oscillator will show the same changes later when corresponding values of peak audio voltage are applied normally to the modulator grid during transmitter operation.

Detailed test procedure follows: (1) Set up one of the variable-voltage d. c. circuits shown in Figure 1. Each of these circuits allows the d. c. voltage to be varied continuously in both positive and negative directions by adjustment of potentiometer R. The levels are indicated by the d. c. voltmeter. In Figure 1(A), two d. p. d. t. switches are required; one to reverse the 6-volt battery, and the other to reverse the meter when changing from positive to negative, and vice versa. No reversing switches are needed in the bridge-type circuit, Figure 1(B), but a center-zero voltmeter scale is required. (2) Switch-on the receiver and the oscillator and modulator in the transmitter but not the output stages of the transmitter. Allow a half-hour warmup period for both transmitter and receiver. (3) Set the d. c. source to zero. (4) Loosely couple the receiver to the oscillator and tune-in the unmodulated carrier at zero beat, using the internal BFO of the receiver. Maintain loosest practicable coupling, to prevent receiver overloading. (5) Vary the d. c. voltage positively in steps of 0.1 to 0.5 volt, recording at each step the corresponding frequency of the beat note. Repeat up to the maximum d. c. voltage. (6) Repeat Step 5, but increasing the d. c. voltage this time in negative steps. (7) From the recorded data, plot a frequency-vs-voltage curve similar to the one shown in Figure 2. This curve shows how positive and negative voltages (such as those due to modulation half-cycles) will frequency-modulate the oscillator. It also shows that the action is linear over only a portion of the range and that curvature sets in, both at the positive and negative ends. The curve in Figure 2, which is for illustration only (though typical), shows linearity from 2 kc. above to 2 kc. below the carrier frequency. Beyond these limits, bending appears and would result in modulation distortion. The modulator to which this curve applies must be operated between voltage swings of approximately +2.5 and —2.5 volts. In other words, in this case, plus and minus 2 kc. would be the maximum undistorted swing permissible under frequency modulation.

It is important to note that the measurements are made on the oscillator in the transmitter. The oscillator

operates at some frequency lower than the transmitter output frequency, since it is followed in the circuit by frequency multiplier stages. Therefore, the frequency values obtained in this test must be multiplied by the number corresponding to the total multiplier-stage action, in order to determine the frequency deviation in the transmitted signal. For example: Suppose the transmitter is designed for operation in the 28-Mc. band and that our FM oscillator operates in the 7-Mc. band. The multiplication factor is 4, which means that a measured ±2 kc. oscillator swing corresponds to a ±8 kc. deviation in the normally transmitted signal. The advantage of testing the FM oscillator only, is elimination of on-the-air interference during the test. Since the multiplier and power amplifier stages of the transmitter do not change the frequency deviation at its origin, they can be disabled during this measurement without influencing test results.

Several methods are available for measuring the beat-note frequency in

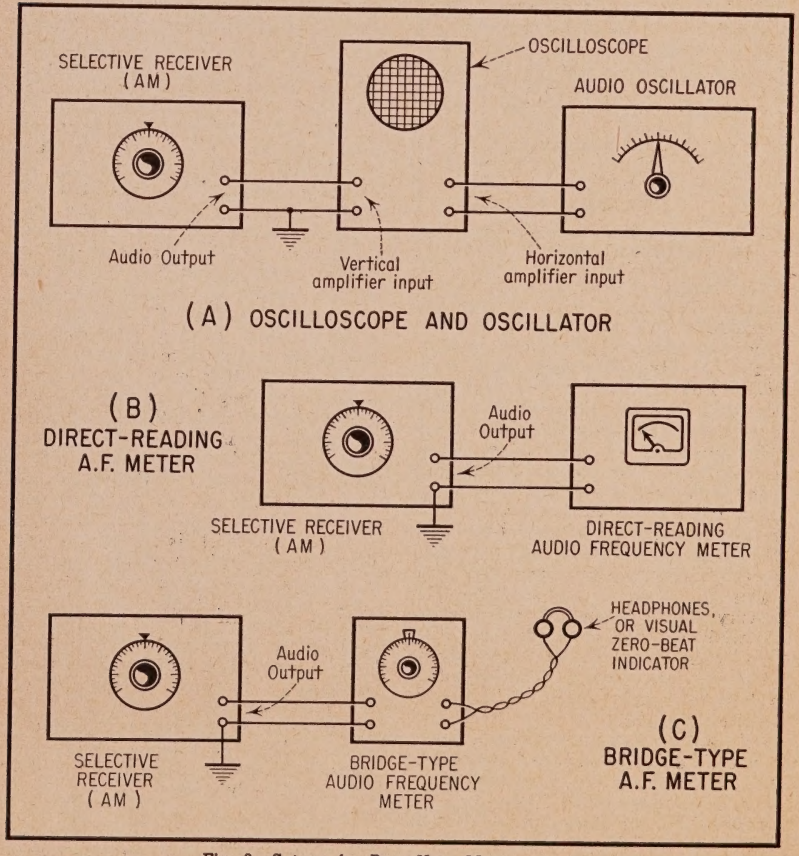


Fig. 3. Setups for Beat Note Measurement.

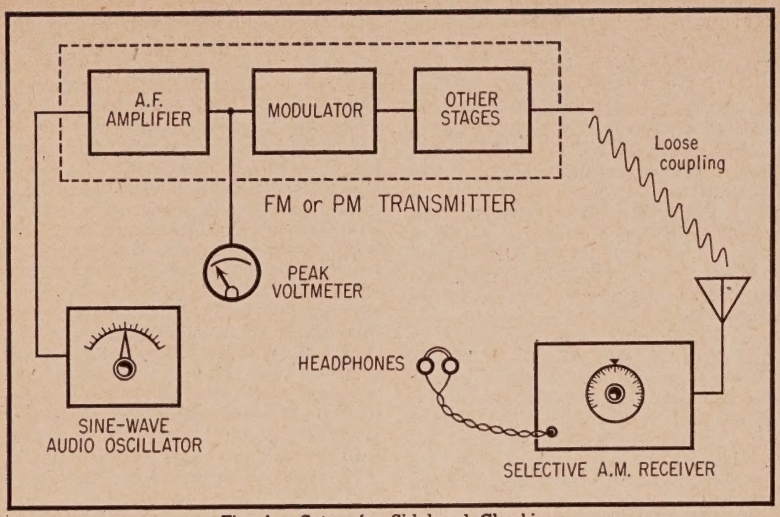


Fig. 4. Setup for Sideband Checking.

the receiver a. f. output. The one selected will depend upon which instruments are available to the operator. Figure 3 shows the three apparatus setups commonly used.

In Figure 3(A), the audio output of the receiver is presented to the vertical amplifier input of the oscilloscope. The oscilloscope horizontal amplifier input is connected to the output of an accurate audio oscillator. The internal sweep and internal sync are switched-off in the oscilloscope. Lissajou's patterns are used for indication. At any beat note, the oscillator is tuned for a stationary circle or ellipse on the screen. The oscillator dial then shows the frequency of the beat note.

A direct-reading audio frequency meter is operated from the receiver output in Figure 3(B). This instrument has a milliammeter which reads direct in cycles per second and thus indicates the frequency of the beat note without necessitating manual adjustments. Since response of the a. f. meter is reasonably free of signal amplitude, settings of the receiver gain controls usually can be ignored.

In the setup shown in Figure 3(C), a bridge-type audio frequency meter with headphones or visual null detector (oscilloscope, magic-eye tube, or a. c. vacuum-tube voltmeter) is used. A common form of this type of a. f. meter is the well-known Wien bridge. The bridge is adjusted for null at the beat frequency, and at this point the frequency is read from the bridge-control dial.

After measurements by the indirect method are completed, a simple peak audio voltmeter may be installed as a permanent monitor at the reactance tube grid. When normal audio modulation is used, the deflection of this meter then will indicate frequency deviation on the basis of the voltage-vs-frequency data previously obtained. Thus, a peak reading of 2.5 v. (in the case illustrated by the curve in Figure 2) would correspond to a frequency deviation of 4 kc. (2000 cycles above and 2000 cycles below the carrier frequency). Where quantitative indications of this sort are not needed, the modulator gain control dial might be inscribed simply to indicate the "danger point" at which

bending of the curve, and resulting distortion, starts.

Sideband Check. The final output signal of the FM transmitter may be examined for bandwidth and sidebands. This is a type of direct measurement and happens to be the only **simple** test that can be applied to an FM transmitter.

Figure 4 shows the apparatus set-up for this type of test. A sine-wave audio oscillator, highly-selective AM receiver (crystal-filter type), and peak audio-frequency voltmeter are required.

The following test procedure is recommended: (1) Allow a half-hour warmup period for both transmitter and receiver. (2) Set the gain control to zero in the audio amplifier section of the transmitter. Switch-off the receiver a. v. c. (3) Using the loosest practicable coupling between transmitter and receiver, tune-in the output carrier. For this purpose, set the crystal for maximum selectivity and adjust the internal BFO of the receiver for any desirable beat note. (4) Set the audio oscillator to 3000 cycles and connect it to the input of the transmitter a. f. channel. Keep the output of this oscillator low (a few millivolts if a high-gain audio section is used in the transmitter). (5) Advance the gain control a small amount, thus increasing the transmitter modulation, but do not touch the output control of the oscillator. (6) Tune the receiver a little above and below the carrier. A single pair of sideband signals will be observed, one 3000 cycles higher than the carrier and the other 3000 cycles lower. No other side frequencies should be found. (7) Advance the gain control further, continuing to do so until a second pair of sideband points is discovered on further tuning of the receiver — one 6000 cycles above and the other 6000 cycles below the carrier. The transmitter gain control setting at which this second pair just appears represents the level at which the transmitter operating characteristic becomes non-linear. The corresponding a. f. voltage level will be indicated by the peak voltmeter and subsequently will show when the point of maximum permissible deviation is reached. Audio levels in excess of this point will result in distortion and excessive bandwidth.

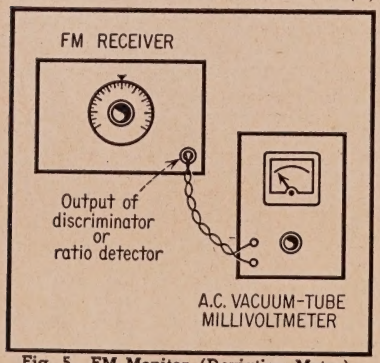


Fig. 5. FM Monitor (Deviation Meter).

The success of this test depends a great deal upon clean, low signal output from the audio oscillator. Excessive oscillator signal amplitude can, by overloading, produce distortion in the audio channel of the transmitter and give rise to sideband components not normally resulting from frequency modulation or phase modulation of the transmitter.

FM Detector Method. When an FM detector (discriminator or ratio detector) is operating efficiently, it is a frequency-actuated, rather than amplitude-sensitive device. Its audio output amplitude then will be proportional to the deviation of the received signal. The detector audio output, measured with a vacuum-tube a. f. millivoltmeter, thus can be used as an indication of deviation frequency.

Figure 5 shows a combination of FM receiver and a. f. millivoltmeter which can be used as an FM deviation monitor. If desired, the entire setup may be built into a single compact unit as a deviation meter. For use exclusively with high r. f. signal levels, a carrier-frequency ratio detector quite possibly can be used without the front-end and i. f. stages of a receiver.

To calibrate the system initially,

the transmitter deviation characteristics first should be checked statically by the d. c. method described earlier in this article, and a curve (Figure 2) plotted. The receiver in the setup shown in Figure 5 then is tuned accurately to the unmodulated output carrier frequency of the transmitter. Next; using a single-frequency audio signal (say, 1000 cycles) and a peak a. f. voltmeter in the transmitter as previously shown, the peak audio signal voltage should be set to correspond to d. c. values at various deviation points on the curve. The millivoltmeter will read only when these audio voltages are applied to the modulator. The corresponding millivoltmeter readings then may be recorded against the deviation readings obtained from the curve. From these data, a reference chart may be prepared or a special frequency-deviation card may be drawn for the meter.

Checking for Presence of A. M. Amplitude modulation is as undesirable in an FM transmitter as frequency modulation is objectionable in an AM transmitter. Fortunately, it is a relatively simple matter to check the output of an FM transmitter for presence of amplitude modulation.

The following procedure is recommended: (1) Connect a small pickup coil to the DIRECT vertical input terminals of an oscilloscope, as shown in Figure 6(A). The vertical amplifier must not be used in this application. (2) Set the INTERNAL SWEEP to its highest frequency, HORIZONTAL GAIN to maximum, SYNC to its INTERNAL position, and VERTICAL GAIN to zero. (3) Loosely couple the pickup coil to the final amplifier tank coil in the transmitter. **(Be cautious of high voltage!)** (4) Switch on the **unmodulated** FM transmitter. Note that a solid band (as in Figure 6B) appears on the oscilloscope screen. If the top and bottom of this pattern are off the screen, increase the separation between the pickup coil and the tank coil, to reduce the signal pickup. (5) Now, modulate the transmitter. There should be no change in the vertical dimension of the band pattern. Any movement of the top or bottom of this band, under modulation, shows the presence of amplitude modulation.

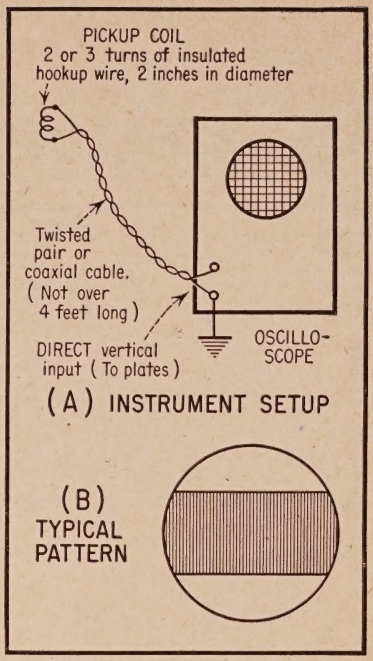

PICKUP COIL
2 or 3 turns of insulated hookup wire, 2 inches in diameter
Twisted pair or coaxial cable. (Not over 4 feet long)
DIRECT vertical input (To plates)
OSCILLO-SCOPE
(A) INSTRUMENT SETUP
(B) TYPICAL PATTERN

Fig. 6. Checking for Presence of A. M.

References

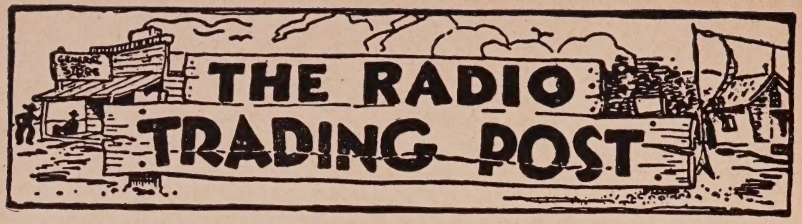
FM TRANSMITTERS AND MEASUREMENTS

The Radio Amateur's Handbook, The American Radio Relay League, Inc., West Hartford, Connecticut.

The Radio Handbook, Editors and Engineers, Ltd., Santa Barbara, California.

BEAT NOTE INDICATORS, PEAK VOLTMETERS.

Basic Electronic Test Instruments, Rufus P. Turner, Rinehart Books, Inc., New York, N. Y.



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CORRECTION

In Figure 1(A) page 4 of the January 1954 issue, a connection should be shown between the common conductor 2, 7, and 10 (lower half of diagram) and the junction of the 2 and 4 ohm resistors.

FOR SALE — Hallicrafter SX42 with R42 bass reflex matching speaker, fine cond., original cost $350, sell for cash to best offer. R. J. Horst, 954 W. Country Road B-2, St. Paul 13, Minn.

FOR SALE — Dumont scope, type 224A, $75; General Radio wave filters, types 830C and 830D, $17.50 each. S. S. Brody, 1814 East 16th St., Brooklyn 29, N. Y.

FOR SALE — Eico tube tester, almost new, also 10" Motorola TV, very good cond., and a Radio City multitester model 447B. Berg's TV and Radio, 3196 Harrison, Box 251, Route 1, Rochester, Mich.

WANTED — 39/44 tube for Philco model 71 radio. Joseph Koterba, 225 Crum Creek Dr., Derwood Park, Woodlyn, Pa.

FOR SALE — Regency RC-600 UHF TV converter, latest model, $25; automatic record changers, $5; 14" TV tube, $10, also yoke, focus coil, and horizontal output trans for same, $5. Would consider trade. James Fred, Russiaville, Ind.

WANTED — Radio books: "Radiotron Designers' Handbook," 4th edition, and Ghirardi's, "Radio & Television Trouble-shooting & Repair." Must be bargain priced. Walt Bartell, 1107 N. Western Ave., Chicago 22, Ill.

FOR SALE — Presto K-10 Recorder (record-cutter). Cuts microgroove or regular at three speeds. Amp. has radio and monitor jacks, used two months, reasonable. Sosville Recording Studio, 712 E. St., Marysville, Calif.

WANTED — 7" portable TV set such as Motorola or Sentinel for cash, test instruments, mikes, amps. 18 to 25 watt, field strength meter, 905 sig. tracer, Solar condenser tester, sweep gen. John Arnold, Box 84, Bluffs, Ill.

SWAP — Unused 20-50L6, 5-14B6, 10-12BE6, 3-12A8GT, 5-7B6, 3-6A7 for unused 6J6, 6SK7, 6SG7, 12AT6, 50C5, 6BC5, 12AZ7, 12BZ7, 25W6, 6BX7, 12A4 types, net for net. C. Elgasser, Jr., 1920 Fern St., San Diego 2, Calif.

FOR SALE — Complete RCA mobile xmtr., built in power, dual vibropacks on 10M, and Triplett sig. gen., 1634, A-1 cond., 10 scales, 100 kc. to 120 mc. Want 30-50 mc. rcvr., AC 110 or 6 v. D.C.; BC923A with or without power supply but oper. cond. C. Ted Fisher, 8641 - 11th Ave., Silver Spring, Md.

WANTED — Late model sig. gen., sweep gen., and 3" or 5" scope. Factory wired units in perf. cond. only. State manufacturer, model number, and lowest delivered price. D. Kurs, c-o Chemical Construction Corp., 525 W. 43 St., New York, N. Y.

WANTED — Turntable and wheel-drive assembly for Motorola R-75 two-tube phono., also low volt and 0-1 mil meters, electric drill, small welder. Will pay cash or swap tubes, parts. L. Olson, 5734 Waring, Los Angeles 38, Calif.

FOR SALE — Multimeter Bradshaw model 10, good cond. Make offer. B. Fogelman, 227 Riverdale Ave., Brooklyn 12, N. Y.

FOR SALE — Mallory Vibrator Tester, model 6VT1, like new, $15. T. E. Bergerud, Killdeer, N. D.

WANTED — "Servicing Receivers by Means of Resistance Measurement," by Rider. William Sharkey, 48 - 50 - 40th St., Long Island City 4, N. Y.

FOR SALE — Riders Manuals 7-9, 11, 16-19, exc. cond., $65. Paul A. Stoudt, Beresford, S. D.

FOR SALE — Alliance model AB5 TV booster; make offer. Greiner Radio Service Company, 299 S. Elmwood Ave., Buffalo, N. Y.

SELL OR SWAP — All-band CW xmtr. with 807 final, $45, or audio equipment. Barry Mozur, 292 W. 236 St., Bronx, N. Y.

FOR SALE — Virgin Presto long shank thermostylist and "How to Understand and Use TV Test Instruments" (2nd Printing, full page test instrument pictures), mint cond. Frank York, Box 101, St. Albans 12, N. Y.

WANTED — Hickok Pattern Gen., model 620, Hickok Traceometer model 156, Hickok sig. gen. model 277 or 288X, only first class equip. considered. Delaney Motion Picture, 494 Cline Ave., Mansfield, Ohio.

FOR SALE — Concertone 1401-D tape recorder basic unit, $225; also Command and Amateur gear. R. E. Clement, Chester Springs, Pa.

SELL OR TRADE — Davis rhombic TV antenna, Remington Remette portable, Recording King guitar, Federal 8 mm. enlarging camera, Dejur Citation 8 mm. movie camera, Elgeet f 3.5 telephoto lens. D. C. Harrington, 2508-B 36th St., Los Alamos, N. M.

WANTED — Folding camera, 120 film size, F6.3 lens or better. Leaky bellows accepted if otherwise OK. Have T17 carbon handmike, flexible shaft, 600 v., 200 mil. transformer, many radio parts. Clinton E. Clark, Middleboro, Mass.

SWAP — Have about 25 new receiving tubes, 6AK5, 6J6 and 25L6 to trade for late model tube tester. I. W. Stubblebene, 140 S. 4th St., Reading, Pa.

SELL OR TRADE — Six unused 304TL's, need good factory wired sig. gen., with oper. instructions. H. Wray, 482 Old Farm Road, Pittsburgh 34, Pa.

SWAP — 500 good books on electricity, radio and television, for sound equip., W. E. 633A mikes or AM-FM tuner. Electronic Service, 4918 Beech Street, Hammond, Ind.

WANTED — 8 mm. camera - projector; Hallicrafter ST-83-SX-62; 10" 630 TV set; 3-speed record changer, Webster or Garrard. Low prices. Alvin Odintz, 359 Wortman Ave., Brooklyn, N. Y.

WANTED — Operating instructions, circuit description, schematic, all other info for Hickok model OS-8 AF-RF Oscillator. S. I. Moritz, 150 - 29 72 Road, Kew Garden Hills 67, N. Y.

WANTED — Supreme model 560-A Vedolyzer and Supreme model 562 audolyzer. Walquartsen Radio and TV, Northfield, Minn.

FOR SALE — Kilowatt phone-cw xmtr, rack and panel job, exc. cond., bring truck and $100. William H. Dore, 276 Gilmore St., Williston Park, N. Y.

WANTED — Pair of 6L6's to single 807 or 1625 mod. trans. (50-60 w.). Also any preselector or preamp. 10-80 m. including RME or McMurdo-Silvers Q5'ers. Richard M. Kayne, 233 Naples Ter., Bronx 63, N. Y.

FOR SALE — 10 meter and 20 meter phone rig, 50 w., separate power supply. Prefer N. Y. vicinity. Herbert Paskin, 1402 Brooklyn Ave., Apt. 5B, Brooklyn 10, N. Y.

WANTED — Oceanic Zenith portable, a pair of binocs, Leica III F camera, tape recorder (except Webster), slide proj., 16 mm. film. Jack Wentworth, 106 So. Dearborn St., Mobile, Ala.

FOR SALE — Like new PE 103A $35, PE 73CM $10, R89/ARN5A glide path rcvr. with crystals $25, A10-A sextant $10. All prices FOB. C. A. Brawner, 7207 Fisher Rd., Route 4, Dallas 14, Tex.

WANTED — Power transformer, 1500 v. center tap, 200 ma. State price and cond. Louis E. Fisk, 3217 Hull Ave., Bronx 67, N. Y.

SWAP — 16 mm. magazine GSAP camera with 115 v. AC power supply for scope, sig. tracer, or RF sig. gen. Edward Radtke, 25 So. Hawthorne St., Manchester, Conn.

WANTED — DC voltmeter, either 0-50 or 0-100 v., prefer Weston model 301, 1000 ohms per volt. Ira I. Walker, 1612 Cent. Ave., Great Falls, Mont.

FOR SALE — National NC-57 comm. rcvr. with S-meter in good operating cond. $75. B. A. Lloyd, 296 Mt. Hope Ave., Dover, N. J.

SWAP — Books: "Radio Fundamentals," "Elementary Radio Servicing," "Advanced Servicing Technique," Supreme diagrams 1926 thru 1939, Sams Protofacts 1 thru 32, for antenna rotator. Earnest Couch, Jr., 1805 College St., Decatur, Ala.

WANTED — Used portable Royal Typewriter, 7" Admiral table TV, tape recorder. Advise cond. and price. J. J. Bobrow, 104 - 21 191st St., Hollis 12, N. Y.

FOR SALE — Precision E-200-C sig. gen., recently calibrated, like new, $45. Send cash or 25% deposit with order. King Electric Company, 18944 Sorrento Ave., Detroit 35, Mich.

SWAP — Universal Roamer II camera, f4.5 lens, with flash attachment, for converted (115 v. AC) ARC-5/R28 VHF receiver and test equip. Need TV sig. gen., Riders manuals, or typewriter in good cond. Wallace J. Balla, Deerwood Manor, Norwalk, Conn.

FOR SALE — CREI course, like new; 3 el. 10 meter beam; Hickok 288X; Meissner Analyst; Gonset 10-11; Stancor St 203A with PE103 and whip. Make offer for all or part. Jim Noland, 2583 Harney St., Omaha 2, Neb.

SELL OR SWAP — Riders manuals Vol. 1 thru 18; Motorola Vibrapack, 300 v. 150 mils. Best offer or will trade for 100-150 w. CW Fone xmitter, or good amateur receiver. Lew Daufman, 5213 Ventnor Ave., Ventnor, N. J.

FOR SALE — Complete code instructograph, $50; C-D BF50 Capacitor Analyzer, $25; Feiler Electronic stethoscope, model TS-3A, $25. Robert Stuckert, Box 103, Fresno, Calif.

WANTED — DeForest 3 and 15 unit receiving sets, DeForest Honeycomb coil tuners and receivers, 1 and 2 secondary, loose couplers or receiving transformers, spark apparatus; Wm. B. Duck Co. catalogues 12-16. Glen Angle, Clear Lake, S. D.

SWAP — Radios: auto, table or portable, and amps. Send for list. Will trade for model railway line or motion picture hobby 8 or 16 mm. or what have you? Modern TV Service, 185 No. 15th St., Bloomfield, N. J.

SERVICE — Instrument kits, Heath, Eico, etc., wired and tested. Nominal fee, work guaranteed, kits must include diagrams. Immediate service. Group price on more than one instrument. C. W. Chastain, 288 Timber Lane, Memphis 12, Tenn.

FOR SALE — Model T601A Pilotuner, used about two hours for tryout. Still in original carton; 2" 0-1 ma. Sprayberry Foundation meter (never used). Make offer. G. W. Winter, 13416 Sherry Ave., Cleveland 11, Ohio.

FOR SALE — Complete Riders vols. 1 thru 17, like new, $85; Vol. 1 Sams, $8; Vibroplex original key with case, $12; 12 base Gretsch accordion with case, $55 Will ship anywhere. Jim McCoy, Box 41, Whitehall, Mont.

FOR SALE — Centralab PC-201 $9, also Simpson model 127 0-50 DC microammeter $5. L. F. Sander, Jr., 211 Henderson Rd., Pittsburgh 9, Pa.

POSITION OPEN — In Ukiah, Calif., experienced TV technician, good pay for permanent man. Merk Radio Shop, Ukiah, Calif.

FOR SALE — Hickok model 680 marker and calibrator; National NC-100; BC-342, 813 tubes; 18 amp. variable voltage xformer. Johnny Wheeler, 3224 Springhill Ave., Mobile, Ala.

TRADE — Sylvania type 131 scope for Meissner 9-1091C tuner, Lyon and Healey 17" TV for Hallicrafters SX62 or SX62U or like. Both nearly new cond., will pay shipping. M. True, R-1254 Roslyn Ave. SW, Canton 10, Ohio.

WANTED — Tuning unit BC-746 for walkie-talkie, need channels 2, 3, or 65. Have 5" RCA-158 scope for sale or trade. J. Lattig, Freeburg, Ill.

FOR SALE — Like new 4D32, Riders TV-2, Riders 14, Millen r-9er. Any reasonable cash offer. C. Osiecki, 65 Vine St., Ansonia, Conn.

FOR SALE — 2 Weston model 301 meters, round case, 0-100 ma. and 0-250 ma., used but perf. cond., each $5.95 postpaid. L. Weinreb, 151 - 09 34th Ave., Flushing, N. Y.

FOR SALE — Heathkit 5" scope, $50; Simpson sig. gen., $45; Heathkit VTVM model V4A, $30; Heathkit sig. gen., $35; Eldico grid dip meter with one coil, $25, all wired. FOB. Max Shively, 3115 Ingham St., Lansing 10, Mich.

WANTED — BC-348 receiver, AC or DC. Robert Ward, Box 214A "Darjeeling", Schwenksville, Pa.

SELL OR SWAP — Boston area. NC-57 with plug-in 6J6 booster for 20 meters, $65, two BC-1206, one converted to 110 v. AC, $15 for both. W. B. Eddy, 10 Aberdeen Rd., Hingham, Mass.

FOR SALE — 670 Hickok scope and 610A Hickok sweep and marker gen., exc. cond., $325. Ralph Dorough, 117 Pecan St., Terrell, Tex.

FOR SALE — Holmes 35 mm. sound-on-film motion picture proj., complete portable with amplifier, speaker, and cords, $135 plus freight. Merton Cooley, 208 Locust St., Allegan, Mich.

FOR SALE — Comb. radio, recorder and phonograph. Makes and plays 78 and 33⅓ records, includes mike, PA system, records from radio, sapphire cutting stylus, attractive carrying case. Carl Solomon, 35 Rainbow Lane, Levittown, N. Y.

WANTED — Tube checker in good working order, very reasonable price. Raymond Fisher, 627 Fallowfield Ave., Charleroi, Pa.

WANTED — PF indexes 26, 30, 31, 33, 34, any before 26. Need diagram, manual, for Triplett comb. model 1125B Volt Ohmmeter, sig. gen. model 1151A. State prices. Arjay Radio Service, 1929 So. Spring St., Springfield, Ill.

FOR SALE — Webster model 50, 78 rpm record changer in perf. cond. Any reasonable offer considered. A. Gasparino, 367 West 35th St., New York 1, N. Y.

WANTED — Plate transformer, primary 115 v., 60 cyc., 1 phase, secondary 2 KV to 3 KV at 500 ma. No center tap req'd. Give weight and max. dimensions with description. R. Kawcyn, 13412 Lambert, East Cleveland 12, Ohio.

WANTED — Tape recorder, new or used. Will swap for anything you may need of equal value. F. Tantillo, 17 Orange St., Abington, Mass.

FOR SALE—Unused Carter super converter for wire and tape recorders 6 v. DC to 115 v. AC 80 w. May be used with Knight, Bell, Crestwood, Dukane, Eicor, Gray, Masco, Pentron, Revere, Web-Cor, Wilson-Gay, Tape Master recorders. $45. Paul Proctor, 1419 Farragut, Laredo, Tex.

TRADE — Automatic Roleiflex f3.5 coated, Heiland Synchronizer, complete multiple flash equip., Hartley field lens, case, shade, tripod, Weston meter. Cost over $420, like new. Want Collins 75-A receiver. Local preferred. Ernest Palinkas, 335 East 69th St., New York 21, N. Y.

WANTED — Old books dealing with stationary steam engines, particularly Corlis Engines. Will pay reasonable cash prices. W. S. Crooks, Box 409, Stow, Ohio.

FOR SALE — Sams Photofacts 2, 3, 10, 13, 15, 18, 20, 44, 51, and 67 thru 213 with binders; Blonder Tongue CA1M comm. antensifier with remote control, weatherproof box. K. F. Stevenson, 70 Flora Court, Concord, Calif.

FOR SALE — Complete NRI radio & TV course. Kit parts are wired to build final receiver, easily disassembled for performing course experiments $40. Walter Rehrig, 205 N. 7th St., Apt. 3, Allentown, Pa.

FOR SALE — Riders manuals 6 thru 14, like new; NC-57 rcvr., A-1 shape; also radio parts. Jensen Radio and Appl., 3529 Dunn Ave., Cheyenne, Wyo.

FOR SALE — Anchor two stage booster, model ARC-101-100, good used const., also Ampro model 731 '53 tape recorder. J. Gamm, 447 Longleaf, Shreveport, La.

FOR SALE — 10" Silvertone walnut plastic table model 9125-B, 21 tubes, powerful, perf. cond., $29. Jones Radio Co., 1115 Rambler Ave., Pottstown, Pa.

SELL OR TRADE — Admiral radio and phono set, 78 RPM, in good cond., model 5B1A-MA, $35 or swap for test equip. S. G. Marotta, 6 Schalk St., Newark, N. J.

WANTED — Complete set of Riders Radio and TV manuals. State price. Joseph Schneider, Box 351, Meredosia, Ill.

WANTED — VTVM for TV servicing in perf. cond., and reasonably priced. Eugene F. Nowak, 1401 S. Austin St., Brenham, Tex.

FOR SALE — Novice band Xmtr. (10-15 w.) complete power supply, all tubes, and Xtal., perf. cond., prefer local deal. D. M. Jellinek, 14 Melman Terrace., Maplewood, N. J.

FOR SALE — Like new VOM using 4 in. meter, 1000 ohms per volt, AC-DC. Postpaid $12.95. A. Weinreb, 151 - 09 34th Ave., Flushing, N. Y.

SWAP — Dozen Sylvania subminiature tubes No. 5840, retails for $9 each, for what have you? H. Dee, Box 114, Verona, N. J.

SWAP — Audio oscillator, 3" CRT unused, synchros, selsyns. Need Jensen Reflex Baffle or equivalent and elec. portable hand saw. S. Consalvo, 2507 Southern Ave. SE, Washington 20, D. C.

FOR SALE — Two BC-654 A's; 2 A eliminators, one heavy duty; 580 v. heavy duty power supply; IP 501 ship receiver; Harley motorcycle, low mileage. A. Morris, 269 Hawthorne Ave., Princeton, N. J.

FOR SALE — Waterman Industrial 3" 11A scope $75; Wilcox 1D10 tape and record recorder $40; McMurdo Silver 906 AM-FM sig. gen. $40. H. I. Griffiths, 39-82 65th Place, Woodside 77, L. I.

WANTED — Hickok 610A sig. gen. Mimna TV, 271 No. 6th St., Newark 7, N. J.

FOR SALE — Precision 912 tube tester, used very little. Will consider trade for "TV Components." Luther V. Strader, 1217 Myrtle Ave., Danville, Va.

WANTED — Riders manuals, complete pre-W.W. II set, quote price and cond. J. Defrees, Triangle Appliance Service, Durhamville, RD 1, N. Y.

FOR SALE — Echophone comm. rcvr. EC3, with speaker, $38, Policalarm FM 152 to 162 Mcs., $40; Zeiss Ikon camera using film packs 3½ x 4½, $40. Paul Gorbatch, Jr., 1506 Steiner Place, Asbury Park, N. J.

WANTED — 16" recording turntable and overhead lathe. State price, condition, model and make. L. J. Schnedorf, 610 Monroe Ave., River Forest, Ill.

WANTED — Heathkit or Eico scope, must be in good operation and reasonable. Prefer local seller. Joseph Springer, 26B Hastings Ave., Rutherford, N. J.

WANTED — Riders TV manuals 5 and up. Best offers for cash. H. M. Love, 20108 Detroit Rd., Rocky River 16, Ohio.

TRADE — Underwood model 4 typewriter for scope, kit or assembled. Walter Bruskiewicz, 1107 N. Western Avenue, Chicago 22, Ill.

FOR SALE — Jerrold all-channel booster, $5; Astatic model AT-1 (four tube) TV booster, $15. Paul F. Bahr, 1013 Indiana St. SE, Albuquerque, N. M.

TRADE — Dismantled H.O. railroad for Viking or Harvey-Wells transmitter or better grade comm. receiver. Don A. Lake, 3601 Myers Ct., Jackson, Mich.

SELL OR TRADE — 10 mtr. converter, $10; 3-4 mc. ARC 5, $10; ½" drill press and motor, $45; Sears water pump, motor and tank, $50; BC-191F Xmtr; RCA 10 meter police mobile Xmtr. D'Adolf, 1877 McKinley Ave., East Meadow, N. Y.

FOR SALE — 12½" Transvision set with DuMont tuner, $25; Transvision tuner, $5. Wm. Henshaw, 46 Front St., Tarrytown, N. Y.

WANTED — 40 m. phone-C.W. Xmtr., around 60 watts de-TVI'd. All correspondence answered. Henry W. Kasper, 625 Jefferson Ave., Niagara Falls, N. Y.

FOR SALE — 3 Talk-a-Phone 10 station master intercoms and 50 w. Masco amp., all in working cond. A. K. Guthrie, 618 W. Fourth, Seymour, Ind.

WANTED — Musical instrument amp, low or medium power, also contact mike for guitar. State price, cond., etc. C. J. Stager, Metedeconk, N. J.

SALE — Brush tape recorder, Hallicrafter S35 mechanical code machine and tapes, Radio and TV course, Gonset 3-30 PA system. C. W. T. H., 17 Locust St. Etna, Pittsburgh 23, Pa.

WILL TRADE — Unused Eicor test equip. for 4 x 5 Pacemaker speed graphic camera. Chuck's Radio Service, 123 South 13th St., Clarinda, Iowa.

WANTED — Sweep gen., Oak Ridge dynamic tube tester and scope. State lowest price. J. Raisman, 1751 Georges Lane, Philadelphia 31, Pa.

WANTED — 5" or 7" scope suitable for TV servicing; crystal controlled marker gen.; and sweep sig. gen. Factory wired units in perf. operating cond. only. State manufacturer, model number, and lowest delivered price. D. R. Kurs, c-o Chemical Construction Corp., 525 W. 43 St., New York, N. Y.

WANTED — 7", 10", or 12" table model TV sets, working or otherwise; also used test equip. Bill Brunner, 318 W. Galer, Seattle 99, Wash.

SELL OR TRADE — Supreme 592 VOM, Electronics 1937-1950, Electronic Industries 1943-1946, Radio 1936-1945, Radio News 1943-1953, Eng. manuals and handbooks, technical manuals. F. D. Bornman, 19491 Lowell Dr., Detroit 3, Mich.

FOR SALE — Radio City Products tube and set tester, model 803, good cond., orig. instruction sheets included, $25; Hickok RFO5 oscillograph, as is, instruction sheets included, $30. Frank Pavlic, 907 Rebecca St., McKeesport, Pa.

WANTED — Old Electro Importing Co. catalog — formerly Gernsback's Wireless Parts Supply Co. of New York City, of early days. Lundberg Radio Service, 1215 W. 6th, Topeka, Kan.

FOR SALE — G.I. recorder-phono assembly, 33⅓ and 78, never used, $15 plus shipping. Or swap for what have you? Joseph A. Domurat, 205 E. Cottage St., Dorchester 25, Mass.

FOR SALE — Micrometer tech. lab. with manuals; Weston 663 tester; four WE 356-A transmitting tubes; two GE thermocouple meters 100 MA; Espey tube-set tester. Make offer. B. Gallin, 380 N. 7th St., Newark, N. J.

WANTED — Riders or Photofacts manuals; ham or comm. receivers, must tune from BC to 30 megcy. and have at least one RF stage, also 400 to 500 kc. i. f. Clark Electronics, 828 N. Gulf, Indian Rocks Beach, Fla.

FOR SALE — Riders radio manuals 1-5 Abgd. and 1-7 inc. some unused, $7.50 ea.; Har-Wells TBS-50A with power and cable, $95; Supreme 504B tube tester, $40; NRI Radio and TV course in binders, $20. A. C. Livingstone, 12-01 Ellis Ave., Fair Lawn, N. J.

FOR SALE — Radio and TV test equip. Will trade two selenium rectifiers and AC transformer rated at 275 v. DC at 2 amp. for typewriter. Virgil Franceschini, 708 Bigler Ave., Barnesboro, Pa.

FOR SALE — Riders manuals 1 to 15 incl. $55; Superior tube tester model 450, $25; RCP multitester model 447, $10; complete mobile 6 v. DC or 110 AC sound unit. Ralph Chasse, 24 Hobson St., Methuen, Mass.

FOR SALE — 1952 National Schools Radio and TV course in binders and tube and shop manuals, etc., $30. Will throw in Ghirardi's Radio Physics course. Gene Melton, Route 6, Wenatchee, Wash.

FOR SALE — Unused 1953 Norelco console TV sets 22½", $175; good used 1/6 and ¼ HP AC motors, $10 each. Paul Capito, 637 W. 21 St., Erie, Pa.

FOR SALE — Meissner 8C FM tuner, used one month. Make offer Maurice E. Sweitzer, 33½ Margaret St., Binghamton, N. Y.

FOR SALE — Riders manuals 1 to 13 incl. and NRI sig. gen., model 88, both in exc. cond. $75 for both. Albert E. Buchanan, 7713 Este Ave., Philadelphia 42, Pa.

FOR SALE — Used 3" round and square meters 8 0-500 mills DC H.F. 7 0-1000-5000 mills thermocouple, 10 ammeters-voltmeters AC and H.F., 25 in all, $45. M. R. English, 6300 Allman St., Philadelphia 42, Pa.

FOR SALE — Heath condenser checker, sig. gen., scope, multitester. S. Bombka, 2828 W. Melrose St., Chicago 18, Ill.

WANTED — Clough-Brengle Grafascope model 126 or 111 frequency modulator, made during 1938 and 1939. Vern K. Sandin, W. 1222 Alice Ave., Spokane 18, Wash.

SELL OR TRADE — Hallicrafter S40B pwr. transformer, 115 v. pri., 2500 v. secondary, 330 MA; Instructorgraph code machine; Grid-dip-meter; high voltage filter condenser for Riders or Sams Photofacts. Clintcn C. Vaughan, Dysart, Iowa.

WANTED — Short wave receiver, perfect cond. not necessary, just so all parts are there. Will pay $50 and down. Gordon Goldsmith, 1772 Autumn Ave., Memphis, Tenn.

SWAP OR SELL — Complete CREI course; Hammarlund 120 X receiver; Motorola auto radio, wall mount; GE table radio. Want ham gear and test equip. Frank T. Cook, RD 3, Amherst, Mass.

SELL OR TRADE — Five Meissner 8CK FM tuner kits with cabinets in sealed cartons, for TV test equipment or good used TV sets. Joe Such, Box 11, Little Rock, Ark.

FOR SALE — Hickok 505A scope, will ship in orig. carton with instruction book. Best offer over $75. Milton Hockenbury, Ringoes, N. J.

FOR SALE — Slightly used Heathkit scope and Heathkit sweep gen., also several used radio and TV instruction books. Robert Fellows, 90 North St., Caledonia, N. Y.

WANTED — Const. diagram for good field strength meter. Jesse Ramey, Rt. 3, 1309 Leeson Ave., Cadillac, Mich.

TRADE — Guitar, Gibson Cromwell and Vibro Mike pick-up to be used with amp., for what have you in radio and TV test equip. Ed Slusarski, 3520 W. 49 St., Cleveland 2, Ohio.

SELL OR SWAP — Like new National SW3 with 80 and 40 meter coils, $15, also Pilot FM tuner fine cond., $18. Need 2 meter receiver or converter. Steward Ringler, 121 South 11th St., Reading, Pa.

WANTED — Copies of Radio's Master Encyclopedia, and Riders Television manuals, 8 and later. Give lowest price first letter. **For Sale** — 10, 12, and 17" TV sets. Charles E. Spitz, 1420 South Randolph St., Arlington 4, Va.

SELL OR SWAP — Precision E-200-C sig. gen.; Simpson 260 VOM for what have you? A. James Smith, 834 Davis St., Gainesville, Ga.

FOR SALE — 3 band Navy receiver (SLR-12-B) by E. H. Scott, no speaker, (103 lbs.), $75. L. Matushefske, 2 Elmont Rd., Elmont, L. I.

SELL OR SWAP — Federal Enlarger No. 440, Argus 35 mm. model A2F camera and complete darkroom outfit, $45. Will swap for TV sweep gen., scope, 14" to 16" TV table model. Edward Kielar, 1051 W. 21st St., Lorain, Ohio.

FOR SALE — Carter dynamotor 350 v., 150 MA., continuous duty; GE model 250 self-charging portable radio; Command transmitter 5.3 to 7 mc., converted to 7 to 7.3 mc. C. Keeler, 66 Franklin St., Port Jervis, N. Y.

WANTED — Used correspondence course in TV servicing with questions and answers. Will pay $5, send description first. Anthony Bruno, 6812 - 11th Ave., Brooklyn 19, N. Y.

FOR SALE — GE JFM FM tuner and cabinet, converted to 88-108 mc., good cond., $15; GE M5C preamp., $3; Webster 56 record changer, 78 RPM with GE mag. cart., exc. cond., $17. C. L. Goebel, 221 W. 233 St., New York 63, N. Y.

SELL OR SWAP — Signal Corps BC-375-E Xmtr. with dynamotor, instruct'n manual, connecting cables, and four tuning units, 150 w. input. Richard Ebeling, 33 Randolph Road, White Plains, N. Y.

SWAP — Edison "Amberola" cyl. machine, 50 records, cabinet model, good cond., and folding camera, f4.5 lens, for anything of equal value. O. V. Howell, Box 463, Mars Hill, N. C.

SELL OR TRADE — WRL "Globe Trotter" 25 w. transmitter, complete with tubes, coils for 10 meters, antenna changeover relay and bypassed for TVI reduction with crystal mike. Want tape recorder, Rider TV or Sams manuals or best offer. Minnick Television, 31 Elm St., Farmington, Minn.

FOR SALE — Like new McMurdo Silver model 909 sweep gen., 2-226 mc. with 0-10 mc. sweep, $25; Triplett VOM, model 2400 with red dot lifetime 6" meter, $25, both for $45. Fred E. Saron, 844 E. 13 St., Brooklyn 30, N. Y.

FOR SALE — 7 tube amp., 20 w., less speaker, A-1 cond., $15; Progressive Radio Edu-kit, will build 15 different radio sets, $10; Falcon camera, takes color film, can be used on 35 mm. slide proj., $4.50. Vernon Khoh, New Salem, North Dakota.

FOR SALE — 1939 Chevrolet master deluxe Delco radio, good cond., $10. William E. Loucks, 131 West Central, Greensburg, Ind.

WANTED — For cash, Panoramic Adaptor for 455 kc. IF. Prefer military surplus in operating cond., or Panadaptor. Give price, circuit, cond., age, availability of manual, scope size, etc. May buy several. Leonard C. Silvern, Slingerlands, N. Y.

SELL OR SWAP — Hallicrafter model S58 AM-FM, and phono, $45; complete NRI course, $40; Zenith portable radio, $45, all good cond. Want 4 x 5 press camera and flash unit, anything in photography or what have you? Corron Radio and TV, 723 W. 3rd St., Dayton 7, Ohio.

WANTED — New or used Conn Stroboscope and good coin radio. Leo Teply, Geddes, South Dakota.

FOR SALE — BC-610-E in exc. operating cond., first $300 takes, all others returned. Keith L. Curtis, Royal, Neb.

SELL OR SWAP — Latest unused Ikonta Super BX, f2.8 Tessar Opton, coated, MX Synch in case. Interested in quality tape recorder, late model. Jules Klenin, 505 E. Main, Lititz, Pa.

FOR SALE — Hickok: generator 288X, scope 305, tube checker 532; Elec. Mfg. Co. VTVM 100 and Sams Photofacts, 1 to 216, make offer for all or part. Everything in A-1 cond. John W. Smith, 113 S. Stricker St., Baltimore 23, Md.

TRADE — 7EP4 CRT for Eico high voltage probe or cash offer. Will not ship. B. B. Manaseri, 540 East 42nd St., Brooklyn 3, N. Y.

FOR SALE — Weston 301 one mil. foundation meter with W.W. resistors and shunts, $11 postpaid. Also matching AC meter, $5. E. E. Bensen, 1006 Prairie Ave., Joliet, Ill.

WANTED — Old-fashioned Magnavox horn type speaker, need not be in operating cond. Martin Gordon, 140 Washington Ave., Vandergrift, Pa.

WANTED — Good tube checker or what have you for Gibson six string Hawaiian electric in perf. cond. Prefer local contact. Murry Liebowitz, 360 - 95th St., Brooklyn 9, N. Y.

FOR SALE — Little used Jensen HNP-51 15" coaxial speaker, ideal for Hi-Fi system. $90 wholesale. Sell for $57.50 FOB Knoxville. E. D. Rogers, 308 Grata Rd., Knoxville 15, Tenn.

SELL OR SWAP — Motorola 7" TV set; three Pilot FM tuners; three 40-50 FM receivers; Knight 15 w. amp. Need late model tube tester, sig. sweep gen., VOM, VTVM. John Broniszewski, 1523 W. Wabansia Ave., Chicago 22, Ill.

FOR SALE — 3 Silvertone manuals $8, Zenith vols. 1 and 2 $5 postpaid; portable Hartman and Braum 0-100 ammeter and 10-60 wattmeter, each $5; 5" square 0-250 MA. panel mounting meter, $5. Albert C. Hart, 207 N. Raymond St., Griffith, Ind.

FOR SALE — Riders manuals 12-20, exc. cond., $75 or best cash offer. Will trade or sell 2 Zenith manuals, 10" PhilcoTV, Watchmaker's Staking tool. Local deal only. Dwight Spencer, Jr., 4607 Cherry Hill Road, College Park, Md.

WANTED — Experienced TV and radio service technician, good position for qualified man. Harry's Television and Radio Service, 710 Georges Rd., New Brunswick, N. J.

FOR SALE — Complete DeForest radio and TV home study course, scope, voltammeter, sig. gen., power supply, tubes, resistors, etc., for home laboratory, $100. Shipped express collect. Andrew D. Crowell, North Country Rd., Miller Place, N. Y.

FOR SALE — Webster-Chicago recorder foundation unit, like new, $35, local only. E. H. Ekblom, 2 Belair Street, Boyleston, Mass.

SELL OR SWAP — Mark II tank transceiver complete orig. in unopened export boxes; six sets dynamic headphones and mikes, spare tubes, antenna, etc., $35, for boat, optical, camera equip., or what have you? George E. Shipman, 159 Catherine Ave., Muskegon, Mich.

FOR SALE — Pickering Compensator, moael 123E, six positions, perf. cond., $7. Louis Skidmore, Men's Residence, St. Lawrence University, Canton, N. Y.

FOR SALE — Webcor model 210 tape recorder, with acessories, $100; Masco model EMM-6 pre-amp., mixer, $20. Both used few hours, exc. cond. Astatic T-3 crystal mike, $10. Fred Alexander, 40 - 06 Vernon Blvd., Long Island City 1, N. Y.

FOR SALE — Sams Photofacts 1-20, $10; Precision 912P tube tester, exc., $40; RCA Senior Voltohmyst WV 97A in sealed carton, $60; Webster ekotape recorder, exc., $70. Alfred Joltin, 285 Hawthorne St., Brooklyn 25, N. Y.

WANTED — Testing equip. needed for study and work in radio and television. Financial circumstances prevent purchase. Equipment will be gratefully acknowledged. George L. Bailey, No. 17281, Box 51, Comstock, N. Y.

SELL OR TRADE—Model 501A U.S. Devices Antenna Rotator, $15; 14-tube Farnsworth GK 140 Series, Chassis broadcast, short wave, FM Hi-Fi, $60; Philco 077 sig. gen., $15; Electronic Mfg. Co., model 110 VTVM, $40. Ed Larason, Ostrander, Ohio.

FOR SALE — Unused Heathkit scope 0-8, expertly wired, test leads and manual comp., $46.50; scope demodulator probe, unassembled, $3.50, plus shipping. Albert H. Steinberg, 18 - 24 Jordan Rd., Fair Lawn, N. J.

FOR SALE — Model 625 Eico tube tester, factory wired, one year old, good working order, $25. William Kemper Jr., 2403 Fifth St., Peru, Ill.

FOR SALE — Back issues: Electronics, Service, Audio Eng., Radio Craft, Radio News, Radio - Electronics, Radio and Television, B.T.L. Record, 1942-1953. Win Kulp, Ridge Rd., Perkasie, Pa.

SELL — Thordarson T11K19 1" scope, with extra scope tube. Needs minor repair. Otherwise perf., $12 postpaid. Riddell, Box 1930, Chicago 90, Ill.

FOR SALE — Compact Allis Chalmers motor generator, perf., Navy specifications: input 115 v. DC, output 120 v. 60 cy., 1.25 KVA, 1.0 KW. Best offer. CCNY, Box 11, Convent Ave and 139th St., New York 31, N. Y.

FOR SALE — Jackson model 645 VTVM 4½" meter good cond., $20; Simpson model 305 tube checker, $20, checks all but sub miniature. No roll chart, good condition. Bayerkohler Elec., Lakefield, Minn.

WANTED — Back issues of C-D "The Capacitor" for 1937, 1939 and 1944. Also QST's Vol. 1, Nos. 4, 6, 8, and 9. Joseph J. Simpson, 85 - 39 152 St., Jamaica 32, N. Y.

SELL — Link model 205 police receiver, 1500-2000 kc. i. f., fb with converter like Gonset, $12; Mallory VP-552 Virbopack, $10; VP-540, $12; VF-223, $2. George H. Goldstone, 1745 W. Boston Blvd., Detroit 6, Mich.

FOR SALE — Portelec model 40M 2-speed transcription player, built-in 10 w. amp. includes high gain mike input, built-in 12" speaker mounted in two piece leatherette carrying case $40. Cash. N. Brenner, 92 Jane St., New York 14, N. Y.

WANTED — Good used radio test equip. for shop. Interested particularly in multitester, sig. gen., sig. tracer, etc. State cond. and prices. Templeton Radio Service, Box 1106, Brady, Tex.

WANTED — Used tape recorder, send details and prices. De Palma Service, Fancher, N. Y.

FOR SALE — Heath TS-2 TV align. gen., $30; Unused Supreme 592 VOM, $25; LS-3 speaker, $6; Turner 211 dynamic mike, $12; coin operated radios, 6-tube, guaranteed, $15. Brown Taylor, 1307 Vultee Blvd., Nashville, Tenn.

FOR SALE — 152-174 Mcs. RCA land station FM receiver Type CR-16A, in orig. shipping cartons, with tubes and crystal (154.13 Mcs.) Mounted in console, $130 FOB. Write for information. R. C. Heintzelman, 3429 Market St., Camp Hill, Pa.

TRADE — Life's picture history of World War II for test equip. or kit. William Bashta, 19447 Keswick St., Reseda, Calif.

FOR SALE — BC-224H receiver — 6AG7 - 807 Xmtr — antenna tuner with RF meter complete ready to go, $75. Will not ship. Charles G. Salzinger, 229 East Drinker St., Dunmore 12, Pa.

FOR SALE — Almost complete DeForest home study radio and TV course. Best offer. R. Nowak, 3848 South Herman St., Milwaukee 7, Wis.

SELL — National SW-3 receiver with power supply and coils for 80, 40 and 20 meters. Exc. cond., $35. M. G. Weiman, 4514 Avenue K, Brooklyn 34, N. Y.

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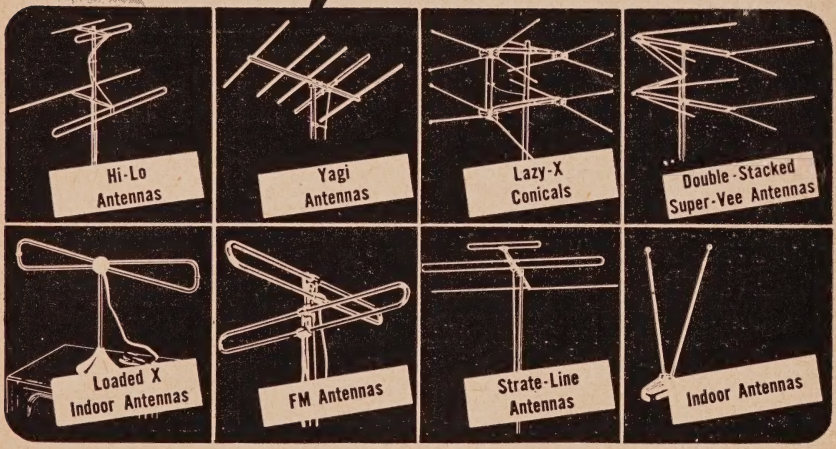
C-D Skyhawk TV ANTENNA LINE



and you'll find excellence in performance and quality, too!

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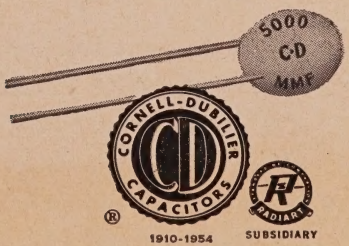

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